

The genus *Chlamydotheca* Saussure (Crustacea: Ostracoda) in northeastern Argentina

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Abstract

The genus *Chlamydotheca* Saussure, 1858 is a typical representative of the Neotropical ostracod fauna that occupies lotic and lentic environments including temporary and permanent ponds. Up to the present, four species have been recorded in Argentina: *C. iheringi* (Sars), *C. incisa* (Claus) and *C. leuckarti* (Claus), and *C. symmetrica* (Vávra). Temporary and permanent ponds of this region were sampled for ostracods, using a fine mesh net. Three species belonging to the genus *Chlamydotheca* were collected of which *C. arcuata* (Sars) is recorded for first time for the Chacoan region. Limb morphology was studied under light microscope and line drawings were made using camera lucida. Valves were photographed under scanning electron microscope and redescrptions of *C. arcuata* and *C. iheringi* are provided and distributional aspects of the species sampled are discussed.

Key words: Argentina, *Chlamydotheca*, new record, non-marine ostracods, redescrptions

Introduction

The family Cyprididae Baird, 1845, comprises nearly half of the current species diversity of non-marine ostracods and has around 170 species that belong to 21 genera recorded in the Neotropical region (Martens *et al.*, 2008).

Among this family the genus *Chlamydotheca* Saussure, 1958 reaches its greatest occurrence in the Neotropical region as indicated by the number of recorded species in Central and South America (e.g. Sharpe,

1903; Roessler, 1986; Higuti *et al.*, 2009). From a Neotropical region, evidences point to a dispersal into North America with species being distributed along the Gulf Coast and up the Mississippi River system (Hoff, 1944). *Chlamydotheca* occurs in South America in both lotic and lentic environments, either permanent or temporary. To date, four species of this genus were recorded in Argentina: *Chlamydotheca iheringi* (Sars, 1909), *C. incisa* (Claus, 1982), *C. leuckarti* (Claus, 1892) and *C. symmetrica* (Vávra, 1898), all of them reported in the Chacoan subregion (sensu Morrone,

2001).

This study provides new information about the distribution of the genus *Chlamydotheca* recorded from the Chacoan subregion in Argentina, as well as the redescription of two species found during sampling.

Materials and Methods

Temporary and permanent ponds were sampled for ostracods during 2008 and 2009 in the provinces of Misiones, Formosa, Chaco, Corrientes and Buenos Aires (Fig. 1). The material was collected using a ladle and a 0.25 mm mesh hand net. In the laboratory samples were sieved using 250 µm sieves. Ostracods were picked from the residue and fixed using 70% alcohol.

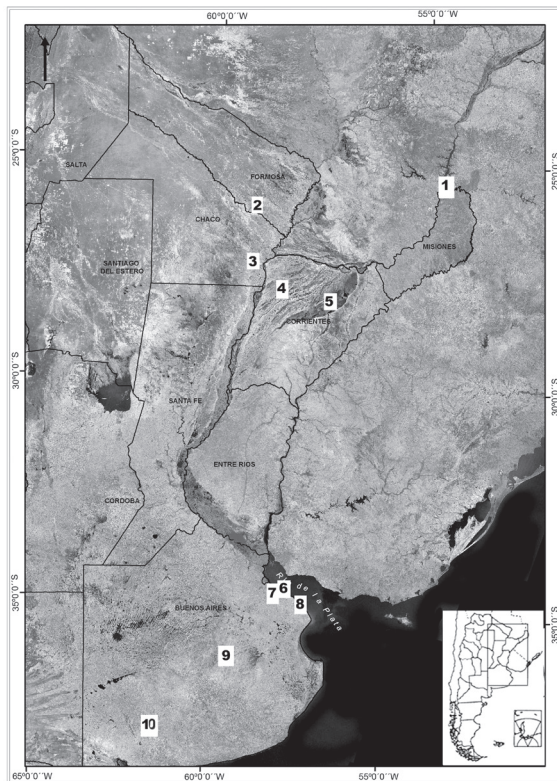


Figure 1. Distribution of genus *Chlamydotheca* in the Neotropical region of Argentina. 1: Misiones province. 2: Formosa province. 3: Chaco province. 4: Soto lake, Corrientes province. 5: Colonia Carlos Pellegrini, Corrientes province. 6: Punta Lara, Buenos Aires province. 7: Pereyra Iraola Park, Buenos Aires province. 8: Magdalena, Buenos Aires province. 9: La Matilde stream, Buenos Aires province. 10: Sierra de la Ventana, Buenos Aires province.

Specimens were dissected under stereo-microscope in polyvinyl-lactophenol.

Limb morphology was studied under light microscope and line drawings were made using a camera lucida at 40× or 80×. Valve dimensions were measured to the nearest 0.01 mm under the microscope at 100×. SEM photographs of the valves were taken using a JEOL JSM 6360 LV scanning electron microscope at the Facultad de Ciencias Naturales y Museo (La Plata, Argentina). The material was identified following Martens *et al.* (1998) and Martens and Savatnalinon (2011). Nomenclature follows Broodbakker and Danielopol (1982) for limb chaetotaxy, the revised model proposed by Martens (1987) for the second antenna, and Meisch's (2000) proposal for the second and third thoracopods.

The following abbreviations are used: Cp = carapace. Valves: H = height, L = length, LV = left valve, RV = right valve. Limbs: An1 = first antenna, An2 = second antenna, Md = mandible, Mx = maxilla, T1 = first thoracic limb, T2 = second thoracic limb, T3 = third thoracic limb, CR = caudal ramus; CRa = caudal ramus attachment. Glo = female genital lobe, n = number of individuals.

Results and Discussion

Class Ostracoda Latreille, 1806
Subclass Podocopa G. W. Müller, 1894
Order Podocopida Sars, 1866
Family Cyprididae Baird, 1845
Genus *Chlamydotheca* Saussure 1858

Chlamydotheca arcuata (Sars, 1901)
Cypris arcuata Sars, 1901
Syn.: *Eucypris* (*Chlamydotheca*) *bennelong*
King, 1905 (*sensu* Daday, 1905)

Material examined: Isla San Martín, Iguazu National Park, Misiones province (25° 41'S – 54° 26'W), 6 females; La Marcela farm, Formosa province (26° 17'S – 59° 08'W), 143 females; Soto lake, Saladas, Corrientes province (28° 16'S – 58° 38'W), 7 females; Colonia Carlos Pellegrini, Corrientes province

(28° 32'S – 57° 11'W), 8 females; Pereyra Iraola Park, Buenos Aires province (34° 50'S – 58° 13'W), 4 females; La Matilde stream, Buenos Aires province (36° 35'S – 59° 39'W), 1 female.

Redescription: Carapace (Figs. 2A-D) tumid in dorsal view, maximum wide just behind the middle, pointed and acuminate anteriorly and rounded posteriorly. In lateral view RV overlaps LV at the anterior and posterior margins. The maximum height more than half length and in the middle of the maximum length. Hinge adont. Dorsal margin rounded, ventral margin convex in the middle of valve. Both anterior and posterior margins rounded, but anterior margin with a lobated fringe. Surface of valves smooth with delicate setae.

RV (n = 200): L = 1.99 mm ± 0.15 (1.80 mm – 1.99 mm); H = 1.03 mm ± 0.02 (0.99 mm – 1.09 mm); LV (n = 200) L = 2.15 mm ± 0.30 (2 mm – 2.20 mm); H = 1.19 mm ± 0.07 (1.02 mm – 1.19 mm).

Anatomy of soft parts (Fig. 3)

An1 (Fig. 3A): 7-segmented. Number of setae per segment (from SI to SVII): 2+1, 1, 1, 2+2, 2+2, 4, 3+ya. Plumose natatory setae slightly shorter than all segment together.

An2 (Fig. 3B): 2-segmented protopodite and 3-segmented endopodite. Second segment of protopodite with one long ventral seta, remainder of exopodite reduced to a plat-like scale consisting of one short, one medium and one long seta. First segment of endopodite large with a ventral aesthetasc (Y) on its interior side. Dorsally with 1+5 natatory setae on the distal zone (the outermost is short and the others reaching at least to tips of terminal claws). There is a smooth long seta at the interior border of this segment. Second segment of endopodite with two long medio-dorsal setae and two subapical t-setae. Two z-setae at the exterior border of this segment, two medium-sized (G_1 , G_3) and one small (G_2) claws. Terminal segment with ventral apex exhibiting a toothed processes, apically bearing one medium (GM) and one small (Gm) 2-serrate claw. Claws G_1 - G_3 and GM set with a row of small teeth.

Md (Fig. 3C): Mandibular coxal typically

sclerotised with a ventro-frontal endite set with nine strong teeth and an unknown number of (sensory) setae, largest tooth with two lobes. Two long subapical hairs and one short dorsal seta also present. Mandibular palp with four segments. First segment with one long smooth seta and two plumose setae (S_1 and S_2). S_2 with a swollen basis. Short smooth alpha-seta (α) also present between S_1 and S_2 . Second segment dorsally with three setae, two long and one shorter. Ventral side with a cluster of five setae three long and smooth, one long, hirsute and a beta-seta (β) relatively narrow, hirsute. Third segment with four subapical, smooth and unequal setae on its dorsal side, medially with one stout, hirsute gamma-seta (γ) ventrally of which three slim but longer setae are situated. Two smooth subapical setae, one long and one shorter, at the ventral side of this segment. Terminal segment with three long sub-equal and three short setae, all smooth.

Rlo (Fig. 3E): With nine teeth.

Mx (Fig. 3D): Consisting of a 2-segmented palp, three endites and a respiratory plate. First segment of palp with five dorsal-apical and two subapical setae, second segment sub-quadrate with six setae, two of which are claw-like. Third endite dorsally with six long sub-equal hirsute setae. Apically with six setae three of which are claw-like. Second and first endites without special features. Respiratory plate with 14 long setulose setae extending from a flat, rounded base.

T1 (Fig. 3F): Protopodite with two short hirsute and sub-equal (a) setae, one longer hirsute (b) seta and one shorter (d) seta. Apically with about 14 setae of different length. Endopodite one segmented bearing at the end three plumose setae. The middle-one longer. Exopodite (respiratory plate) consisting of four hirsute rays.

T2 (Fig. 3G): 2-segmented protopodite with one long seta d_1 on the first segment and one long seta d_2 on the second segment. Endopodite with four segments. First segment elongated with two unequal ventral setae subapically inserted. Second segment with one terminal, hirsute seta. Third segment with two hirsute setae, one about four times the length

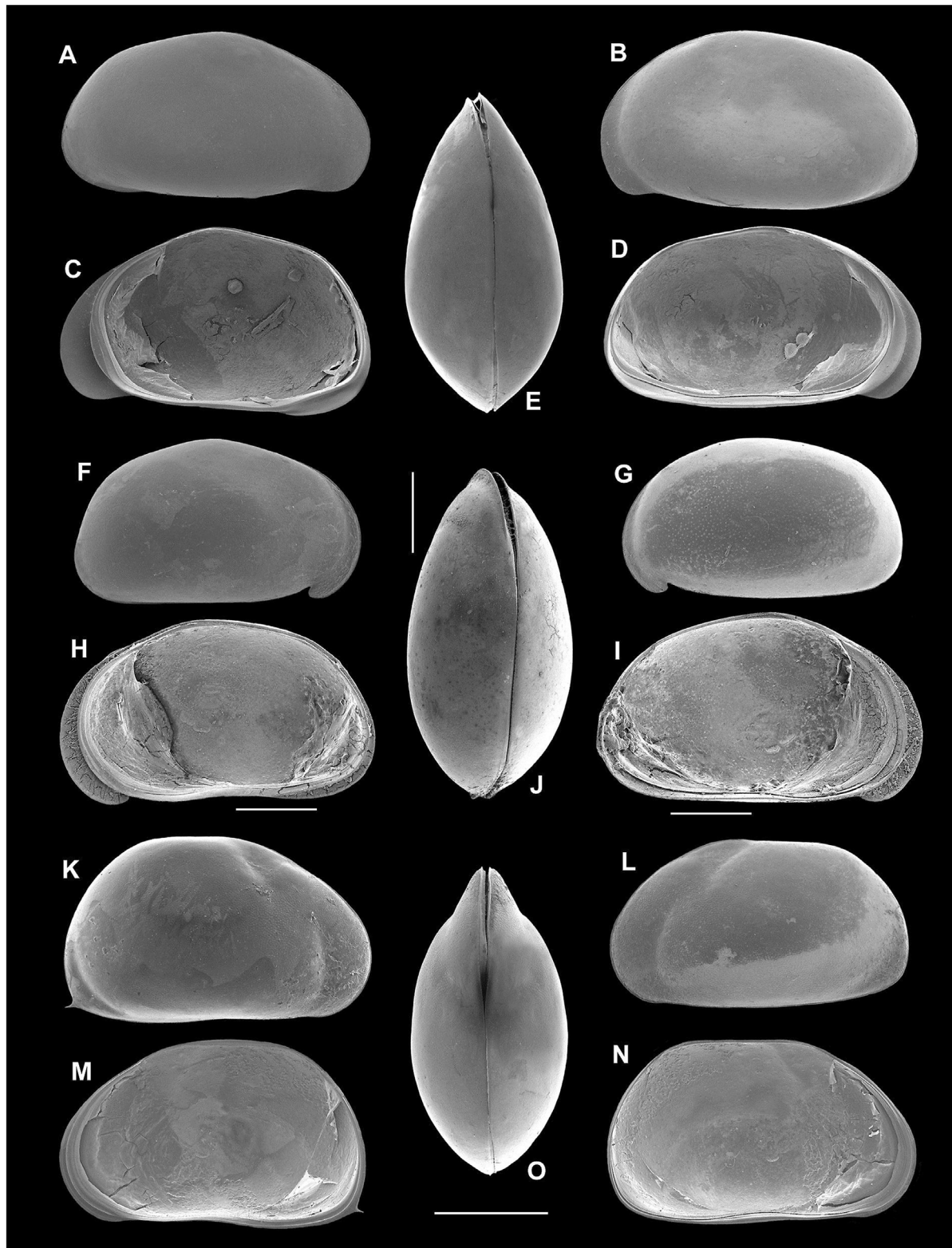


Figure 2. (A) ♀ *Chlamydotheca arcuata*, RV/EV. (B) ♀ *C. arcuata*, LV/EV. (C) ♀ *C. arcuata*, RV/IV. (D) ♀ *C. arcuata*, LV/IV. (E) ♀ *C. arcuata*, Cp/DV. (F) ♀ *Chlamydotheca incisa*, RV/EV. (G) ♀ *C. incisa*, LV/EV. (H) ♀ *C. incisa*, RV/IV. (I) ♀ *C. incisa*, LV/IV. (J) ♀ *C. incisa*, Cp/DV. (K) ♀ *Chlamydotheca iheringi*, RV/EV. (L) ♀ *C. iheringi*, LV/EV. (M) ♀ *C. iheringi*, RV/IV. (N) ♀ *C. iheringi*, LV/IV. (O) ♀ *C. iheringi*, Cp/DV. DV: dorsal view. EV: external view. IV: internal view. Scales: 100 µm.

of the other one. Terminal segment short with an apically long and strong curve serrated claw. A ventro-apical seta and a subapical seta, both hirsute.

T3 (Fig. 3H): Protopodite consisting of one elongated segment with three long setae. Endopodite 3-segmented, the first-one is elongated with one hirsute subapical seta, the second-one with one medio-lateral seta. A distal pincer organ consisting of the third segment fused with distal part of the second segment. Short terminal segment with a beak like claw and a reflexed seta. Apically with a strongly bent and serrate seta. Concave lobe finely haired, pseudochaetal formations M_1 and M_2 well developed. Setae pz_1 and pz_2 also present.

CR (Fig. 3I): Symmetrical, slender, and nearly straight. The entire posterior edge serrated. The anterior (Ga) and posterior (Gp) claws serrated with the Ga being longer. The anterior (Sa) and posterior (Sp) setae subequally long and serrated. Seta Sp located close to Gp.

CRa (Fig. 3J): Slender and without loops, with the ventral branch (vb) more curved than the dorsal branch.

Glo (Fig. 3K): As in figure.

Habitat: This species was found in streams and temporary ponds rounded by pasture and also found in dry sediments.

Remarks: Sars (1901) recorded *Chlamydotheca arcuata* in mud from Itatiba, Brazil, and the specimen from this study is similar but smaller, with the RV overlapping the LV and curved caudal ramus. Daday (1905) recorded *C. arcuata* in Paraguay and Gran Chaco, observing differences in the morphology of the caudal ramus, which is straight, slim and denticulated, while the dorsal seta is 1/3 shorter than the ventral seta. *Chlamydotheca arcuata* was redescribed by Tressler (1949) from localities of the Nearctic region (Ohio, Florida, Louisiana), Mexico and Itatiba in Brazil. Specimen in this study presents some differences with respect to Tressler's description, mainly that the LV overlaps the RV, the natatory setae of An2 do not reach the tips of the terminal

claws, the caudal ramus is pectinated with the dorsal seta half the length of the ventral seta, and the dorsal claw shorter than the dorsal seta. Kotzian (1974) compared *C. deformis cearaensis* (syn. (partim) *C. arcuata* sic Martens and Behen, 1994) with *C. riograndensis*; and also found differences in the morphology of the valves and the caudal ramus, in which the dorsal seta was the same length as the ventral seta. Roessler (1985) compared *C. arcuata* and *C. colombiensis* noting that the caudal ramus of *C. colombiensis* is straight and slightly curved. *Chlamydotheca arcuata* represents a new record for Argentina.

Chlamydotheca iheringi (Sars, 1901) Klie,
1931

Cypris iheringi Sars, 1901

Material examined: La Marcela farm, Formosa province (26° 17'S – 59° 08'W), 8 females; km 955, National Route 11, Chaco province (27° 48'S – 59° 16'W), 8 females; Colonia Carlos Pellegrini, Corrientes province (28° 32'S – 57° 11'W), 5 females; Parque Pereyra Iraola, Buenos Aires province (34° 50' S – 58° 13' W), 8 females.

Redescription: Carapace (Figs. 2K-N) large and elongate. Both valves equal with irregular and asymmetrical curves. Valves with similar outline with irregular and asymmetrical arches. The LV with a rhomboid extremity at the posterior end. The RV with a conspicuous sharp with a spine in the inferior corner and is greater than the left one. Greatest height after the middle section and greater than the half of the length. Hinge adont. Muscle scars clear and numerous. Color of valves greenish pale.

RV (n = 60): L = 3.50 mm ± 0.13 (3 mm – 3.50 mm); H = 2.15 mm ± 0.06 (1.99 mm – 2.20 mm).

LV (n = 60): L = 3.50 mm ± 0.19 (3 mm – 3.60 mm); H = 2.09 mm ± 0.05 (2 mm – 2.10 mm).

Anatomy of soft parts (Fig. 4)

An1 (Fig. 4A): 7-segmented. Number of setae per segment (from SI to SVII) 2+1, 1+ Rome-organ, 1+1, 2+1+1, 2+2, 1+4, 2. Plumose natatory setae shorter than all

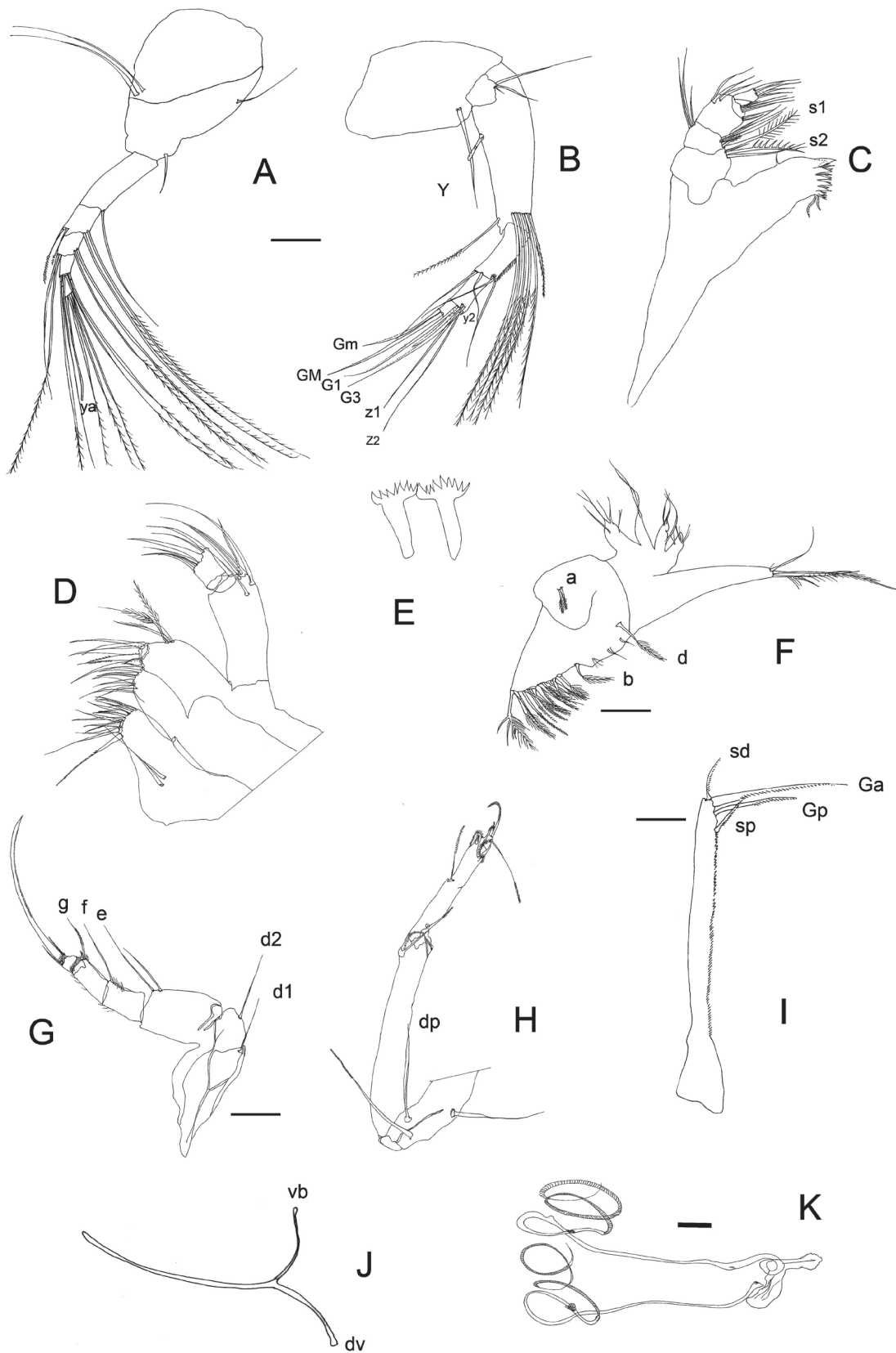


Figure 3. *Chlamydotheca arcuata*. (A) ♀ An1. (B) ♀ An2. (C) ♀ Md. (D) ♀ Mx. (E) ♀ Rlo. (F) ♀ T1. (G) ♀ T2. (H) ♀ T3. (I) ♀ CR. (J) ♀ CRa. (K) ♀ Glo. Scales: 50 µm.

segments together. Rome-organ (r) small. Aesthetasc (ya) just about the length of SIII.

An2 (Fig. 4B): 2-segmented protopodite and 3-segmented endopodite. First segment of protopodite with two setae. Second segment with one apical seta remainder an exopodite consisting of one short seta. First segment of endopodite large with a ventral aesthetasc (Y) on its interior side. There are also 1+5 natatory setae on the distal zone (the outermost is short and the others extend just up to tips of terminal claws). There is a smooth long seta at the interior border of this segment. Second segment of the endopodite with two unequal medio-dorsal setae and four subapical setae inserted on the external side. There are two medium-sized (G_1 , G_3) and one (G_2) short claws. At the exterior border of this segment there are three z-setae (Z_1 , Z_2 , Z_3). Terminal segment with ventral apex exhibiting a toothed process and apically bearing one large (GM) claw, one seta and one aesthetasc (y_3). Claws G_1 - G_3 and GM set with a row of small teeth.

Md (Fig. 4C): Mandibular coxal with eight teeth and an unknown number of small setae, largest tooth with two lobes. Two subapical hairs also present. Mandibular palp 4-segmented. First segment with one long smooth seta. Short smooth alpha-seta (α) also present between two long plumose setae (S_1 and S_2). Second segment dorsally with two long sub-equal setae and one short apically situated, ventrally with three sub-equal smooth setae, one long hair and one short beta-seta (β). Third segment with four subapical, smooth and unequal setae on its dorsal side, ventrally with four unequal smooth setae and subapically with one stout, hirsute gamma seta (γ). Terminal segment of with three apical setae.

Rlo (Fig. 4D): With 9 teeth.

Mx (Fig. 4E): 2-segmented palp. First segment of palp elongate with five dorsal apical setae and two subapical setae. Second segment sub-quadrate with six smooth setae three of which are longer and claw-like. Third endite ventrally with one medio-lateral seta, dorsally with one hirsute subapical seta, two long and three short smooth setae. Apically

with five smooth setae, two of which large and *Zahnborsten* also smooth and one claw-like seta shorter. Second and first endites without special features.

T1 (Fig. 4F): Protopodite with three short and smooth (a) seta, one short hirsute (d) seta and one long and smooth (b) seta. Endopodite bearing at the end two long plumose setae and one smooth shorter.

T2 (Fig. 4G): 2-segmented protopodite and 4-segmented endopodite. First segment of protopodite with one long seta d_1 present. Second segment of protopodite with seta d_2 present. First segment of endopodite with one long seta on its dorsal side. Second and third segment with one long seta subapically inserted. Terminal segment short, with a terminal long and strong curve claw serrated, a ventro apical seta and a subapical short seta.

T3 (Fig. 4H): Protopodite consisting of one elongated segment with three long, hirsute setae. First segment of endopodite large and with one subapical seta. Second segment with one plumose medio-lateral seta. Third segment of endopodite minute forming a pincer shape organ with the apical part of the second segment. Terminal segment with a beak-like claw and a reflexed seta. Apically with a strong bent and serrate seta. Concave lobe finely haired, pseudochaetal formations M_1 and M_2 well developed. Setae pz_1 and pz_2 also present.

CR (Fig. 4I): Caudal ramus just about 2.3 times the length of the anterior claw (Ga). Posterior claw (Gp) just about 3/4 of the length of the anterior-one and the two setae (Sp and Sa) are just the middle length of Ga. Claws Gp and Ga with a row of small teeth.

Glo (Fig. 4J): As in the figure.

Habitat: This species was found in temporaries ponds.

Remarks: *Chlamydotheca iheringi* was recorded in Río Grande do Sul, Brazil (Higuti *et al.*, 2009). It also has been recorded in temporary ponds in Buenos Aires province (Laprida, 2006).

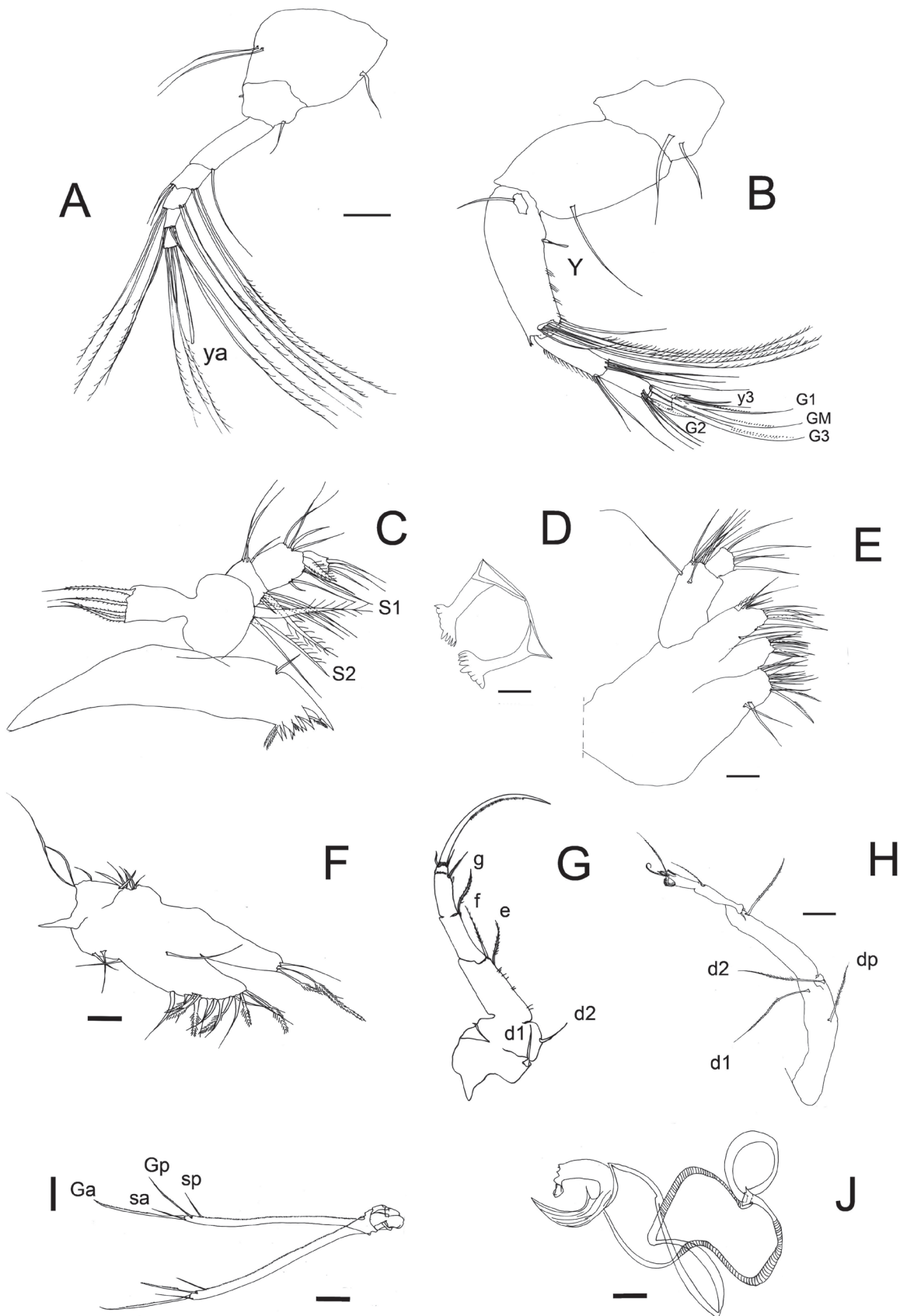


Figure 4. *Chlamydotheca iberingi*. (A) ♀ An1. (B) ♀ An2. (C) ♀ Md. (D) ♀ Rlo. (E) ♀ Mx. (F) ♀ T1. (G) ♀ T2. (H) ♀ T3. (I) ♀ CR. (J) ♀ Glo. Scales: 50 µm.

Chlamydotheca incisa (Claus, 1892)*Pachycypris incisa* Claus, 1892Syn.: *Cypris (Eucypris) limbata* Wierzejski, 1892Syn.: *Cypris labiata* Sars, 1901Syn.: *Chlamydotheca alegrensis* Tressler, 1950Syn.: *Chlamydotheca incisa clara* Roessler, 1986Syn.: *Chlamydotheca incisa obscura* Roessler, 1986

Material examined: La Marcela farm, Formosa province (26° 17'S – 59° 08'W), 12 females; km 955, National Route 11, Chaco province (27° 48'S – 59° 16'W), 1 female; Soto lake, Saladas, Corrientes province (28° 16'S – 58° 38'W), 8 females; Colonia Carlos Pellegrini, Corrientes province (28° 32'S – 57° 11'W), 12 females; Punta Lara, Buenos Aires province (34° 49'S – 57° 59'W), 82 females; Parque Pereyra Iraola, Buenos Aires province (34° 50'S – 58° 13'W), 63 females; Magdalena, Buenos Aires province (35° 05'S – 57° 48'W), 20 females; La Matilde stream, Buenos Aires province (36° 35'S – 59° 39'W), 6 females; Sierra de la Ventana, Buenos Aires province (38° 08'S – 61° 47'W), 32 females.

Description: Carapace (Figs. 2F-J) height greater than the middle of its length. The same happens with the relationship width-high. Ventral section of the anterior border of both valves with a notch. Hinge adont. Muscle scars conspicuous and typically visible on both exterior and interior of valve. Inner lamella well developed. Anterior radial pore canals simple and very numerous; posterior radial pore canals simple and less numerous. Color of valves green.

RV (n = 194): L = VD: 2.30 mm ± 0.11 (2.15 mm – 2.43 mm); H = 1.30 mm ± 0.15 (1 mm – 1.50 mm).

LV (n = 194): L = VD: 2.41 mm ± 0.13 (2.20 mm – 2.60 mm); H = 1.43 mm ± 0.12 (1.30 mm – 1.60 mm).

Habitat: This species was found in streams and temporary ponds in Buenos Aires province. In the locality of Punta Lara, Buenos Aires province, recorded physico-chemical

parameters were: T°: 16.5 C, pH: 7.02. This species was also collected in a temporary pond in the Provincial Route N° 36 in Buenos Aires, where the whole surface of the carapace of the specimens appeared colonized by ciliates *Epistylis* sp. Water conditions were as follows: conductivity: 210 µS cm⁻¹; DO: 7.24 mg/l⁻¹; T°: 5.28° C; pH: 8.74; TDS: 140 mg/l. In the locality Punta Indio, it was collected with the following water conditions: T°: 28.7° C; conductivity: 757 µS cm⁻¹; TDS: 368 mg/l; pH: 7.63; O₂: 8.8 mg/l⁻¹. *Chlamydotheca incisa* is characteristics of temporary ponds in oligohaline waters (Laprida, 2006).

Distributional remarks: *Chlamydotheca incisa* has been recorded in two provinces in the western of Argentina (Claus, 1893; Wierzejski, 1893) and in Buenos Aires province (Ramírez, 1967; Moguilevsky and Whatley, 1995, César *et al.*, 2001). It was also recorded in fossil sediments in Entre Ríos province (Zabert and Herbst, 1986).

Final Considerations

Non-marine ostracods have been widely used as potential bioindicators in the Palearctic region, where their abundance has been related to different waterquality levels and physico-chemical variables (Milhau *et al.*, 1997). Furthermore, the current distribution of ostracods in lakes of the north-central USA (Nearctic) shows that ostracod abundance is influenced by the concentrations of major ions such as calcium, sulphate and bicarbonate (Smith, 1993). Besides this applications, in recent years *Chlamydotheca incisa* has been repeatedly recorded in northern Italian ricefields (Rossi *et al.*, 2003) and in lowland man-modified springs also in northern Italy (Pieri *et al.*, 2007) as a pioneer species. Taking into account the similarities of those Italian water bodies to the ones sampled in northeastern Argentina, we conclude that there is need for further revision of the geographical distribution of this genus and its occurrence in relation to environmental

variables. In this occasion, the occurrence of a species of the genus *Chlamydotheca*, *C. arcuata* (Sars), is recorded for the first time for the Chacoan subregion of the Neotropical region, representing a new record for Argentina.

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